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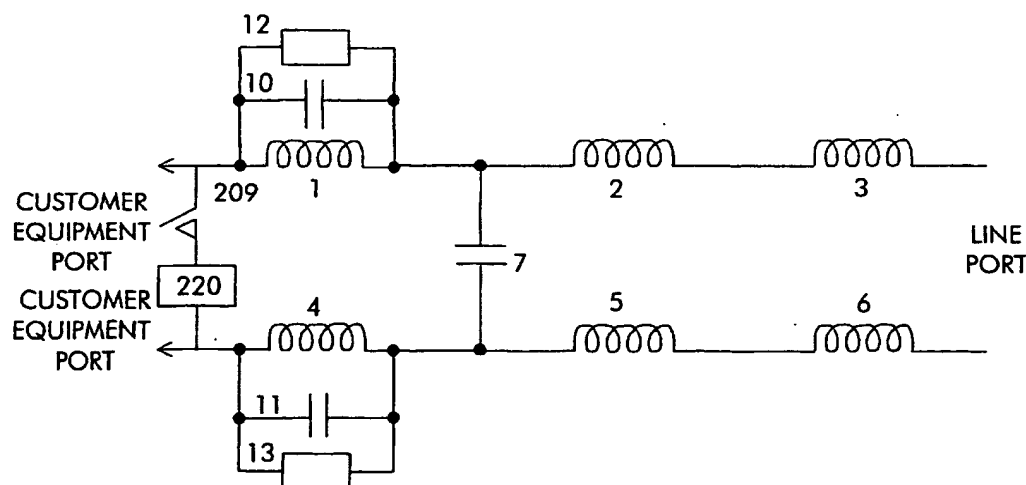
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- (71) Applicant (for all designated States except US): ALCA-TEL [FR/FR]; 54, rue La Boétie, F-75009 Paris (FR). For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
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(54) Title: ADSL FILTER



(57) Abstract: An ADSL/POTS filter includes a switchable impedance (220) which is inserted on the low frequency side of filter (2, 3, 5, 6, 7). The impedance is switched by switch (209) which is controlled by a line sensor so that the impedance is switched into the circuit when the telephone (44) goes off-hook.

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ADSL FILTER**Technical Field**

This invention relates to a filter circuit, and will be described with reference to an ADSL/POTS filter .

5 Background Art

ADSL transmission systems require low pass filters at the customer end to prevent high frequency ADSL signals from interfering with the POTS service and also to prevent HF transients from the POTS interfering with the ADSL transmission.

10 In the context of a telephone line carrying both ADSL & POTS signals, it has been found that multiple in-line filters on a single line cause progressive degradation of return loss at the POTS/Line ports.

 The Application No. 36813/99 (Docket No. 120191) discloses the use of a switched capacitor to change the filter characteristics when the phone goes off-hook and to reduce the effect of multiple filters on the one line. This may, for example
15 change the filter from a second order filter to a fourth order filter.

Disclosure of the Invention

 According to the present invention we propose to use a switched impedance inserted on the low frequency side of the filter to change the filter characteristics when the customer equipment (such as a phone) goes off-hook.

20 In a further embodiment we propose the use of a complex impedance rather than a capacitor as the switched impedance. In this embodiment both the filter rolloff characteristics and telephone sidetone performance are improved.

Brief Description of the Drawings

 Figure 1 shows an arrangement in which the filter characteristics are altered
25 by inserting a switched capacitance as an element of the filter.

 Figure 2 shows a circuit embodying the invention.

 Figure 3 shows an embodiment of a return loss correction circuit for use in the circuit of figure 2.

 Figure 4 shows an embodiment of the invention employing an innovative
30 switching arrangement.

Figure 1 shows a filter arrangement incorporating a switchable capacitor, 8, within the filter.

The filter includes the inductors 2, 3, 5 and 6 and the capacitor 7 as well as the switchable capacitor 8 connected between the junction of inductors 5 and 6 and
5 via switch 9, the junction of inductors 2 and 3.

When switch 9 is open and capacitor 8 is disconnected from the filter, the filter has a second order lowpass characteristic. Closing the switch 9 incorporates the capacitor 8 into the filter and substantially alters the filter performance. The filter then has a fourth order characteristic with faster roll-off rate and the roll-off point is
10 moved to a substantially higher frequency, so that the filter passes more of the higher frequency band.

In a known embodiment, described in our Application No. 36813/99 (Docket No. 120191), the switch 9 is a metallic switch operated by an electro-magnetic relay coil (not shown) incorporated in the telephone loop. Thus, when the phone goes
15 OFF-HOOK, the relay is energized and closes the switch 9.

According to an embodiment of our present invention, we do not modify the order of the filter by using a switchable capacitor as an element of the filter.

Preferably, we provide a return loss correction function activated when the customer equipment goes off-hook by incorporating a switchable impedance on the
20 low frequency side of the filter. Because we do not alter the filter characteristics, we reduce the consequences of the change in filter characteristics.

As shown in the embodiment of Figure 2, we incorporate a switchable return loss correction circuit including impedance 220 between the customer equipment port and a fixed return loss correction circuit 1, 4, 10, 11, 12, 13, the fixed return
25 loss circuit providing correction over a first range, for example, 2 to 4 kHz. The switchable return loss correction circuit 220 by closing switch 209 provides correction over a wider range, e.g. 3 to 20 kHz. The fixed return loss circuit is balanced between the two wires of the line.

We have found that when the filter is to match a complex impedance
30 the return loss characteristics can be improved by using a complex impedance to

more nearly approximate the reference impedance than is possible with the use of a capacitor alone.

As shown in Figure 3, the switchable return loss correction circuit includes a capacitor 221, an inductor 222, and a resistor 223. These components are chosen
5 to optimize return loss when the line is looped.

The fixed return loss correction circuit is automatically connected across the line by line sensing means such as a relay which is activated by the line current when the line is looped.

In a further inventive embodiment we use a novel solid state switch instead of
10 an electro-mechanical relay.

According to the first embodiment of the switch there is provided a polarity insensitive solid state switch controlling a shunt load, the switch including:

- first and second transistors connected in anti-parallel in series with the shunt load; and
- 15 - a longitudinal current sensor controlling the control electrodes of both transistors.

Preferably, the current sensor is a current sensing resistor in series with a second load. Each transistor may be a bipolar transistor and the current sensing resistor is preferably connected between the base and emitter of each transistor.

20 A circuit embodying this switch is shown in Figure 4. A pair of transistors 41, 42 are connected in anti-parallel in series with a return loss correction circuit including capacitor 46, inductor 47 and resistor 48. A load sensing resistor 43 is connected between the base and emitter of each of the transistors 41, 42. The transistors 41 and 42 are arranged so that they are both "OFF" when the line is not
25 looped (no line current), and so that one or other of the transistors is "ON" when the line is looped (line current present), the voltage drop across resistor 43 switching one of the transistor "ON" depending on the line polarity as shown resistor 43 is connected from the emitter to the base of transistor 41, and from the base to emitter of transistor 42 assuming, e.g., that the upper line is positive with reference to the
30 lower line. Thus the base-emitter voltage applied to transistor 41 by resistor 43 is in the opposite sense to that applied to transistor 42.

As shown in Figure 4 the switchable return loss correction circuit 46, 47, 48 is connected on the low frequency side of filter 412, 413, 414. In this embodiment, another return loss correction circuit, 409, 410, 411, 415, 416, 417 is connected between the switchable return loss correction circuit and the filter.

The claims defining the invention are as follows:

1. A communication filter arrangement incorporating a switchable return loss correction circuit, wherein the switchable return loss correction circuit is inserted on one side of the filter.
- 5 2. An arrangement as claimed in claim 1 wherein the filter is a low pass filter, and the switchable return loss correction circuit is inserted on the low frequency side of the filter.
3. An arrangement as claimed in claim 1 or claim 2 wherein a fixed return loss correction circuit is inserted between the filter and the switchable return loss
- 10 correction circuit.
4. An arrangement as claimed in any one of claims 1 to 3 wherein the switchable return loss correction circuit includes a switch in series with a complex impedance.
5. An arrangement as claimed in any one of claims 1 to 4 including a line
- 15 sensor to monitor the line status, the line sensor switching the switchable return loss correction circuit across the line when the line is in a first condition and switching the switchable return loss correction circuit off when the line is in a second condition.
6. An arrangement as claimed in claim 5 wherein the line sensor senses whether the line is looped as the first condition, and unlooped as the second condition.
- 20 7. A communication line return loss arrangement substantially as herein described with reference to the accompanying drawings.
8. A polarity insensitive solid state switch controlling a shunt load, the switch including:
 - first and second transistors connected in anti-parallel in series with the
 - 25 shunt load; and
 - a longitudinal current sensor controlling the control electrodes of both transistors.
9. A switch as claimed in claim 8 wherein the current sensor is a current sensing resistor in series with a second load.
- 30 10. A switch as claimed in claim 8 or claim 9 wherein each transistor is a bipolar transistor and the current sensor connects the base emitter of each transistor.

11. An ADSL/POTS filter including a high frequency shunt circuit in parallel with a telephone subset, the filter including a switch as claimed in any one of claims 1 to 4 in series with the high frequency shunt circuit, the current sensor switching on one of the transistors when the phone line is looped.

5 12. A switch as claimed in claim 3 wherein each transistor is an NPN transistor.

13. A bi-directional switch substantially as herein described with reference to the accompanying drawings.

14. A filter arrangement as claimed in any one of claims 1 to 6, including a switch as claimed in any one of claims 8 to 13.

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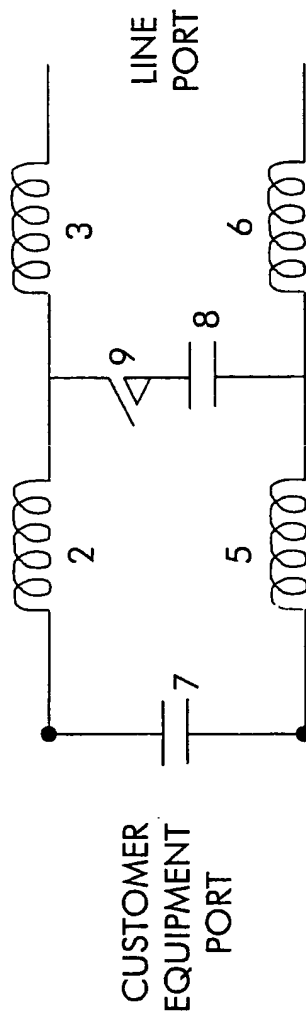
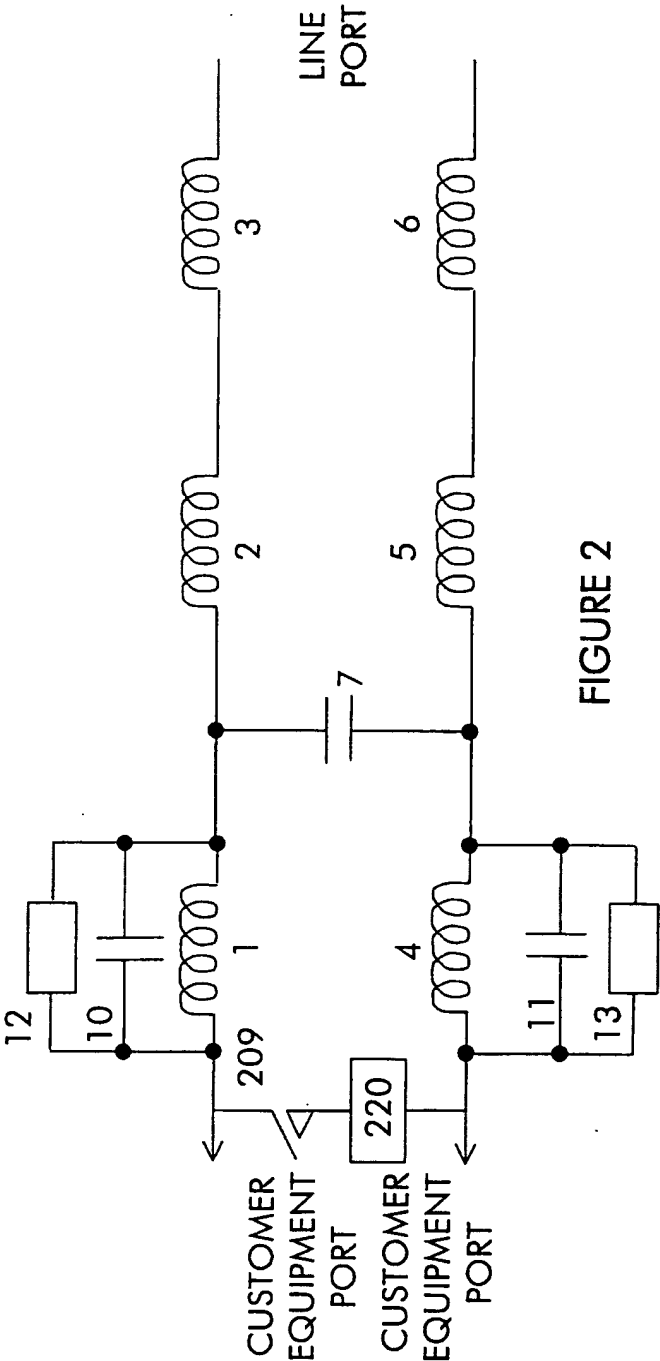


FIGURE 1



3/4

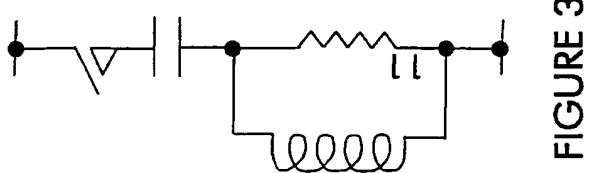
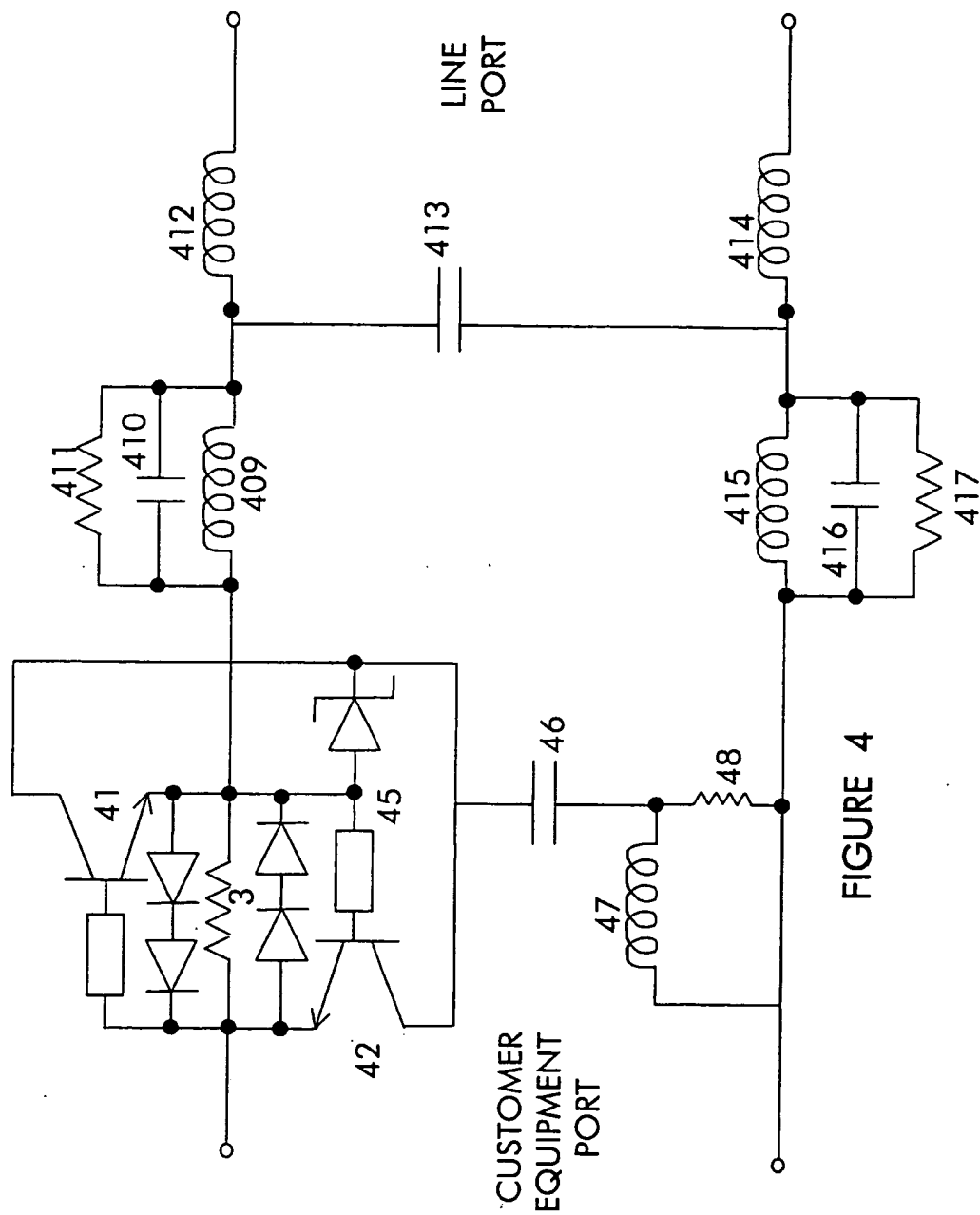


FIGURE 3

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU00/00995

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|--|--|---|--|---|---|--|---|--|--|---|--|--|
| A. CLASSIFICATION OF SUBJECT MATTER | | | | | | | | | | | | |
| Int. Cl. ⁷ : H03H 7/12 | | | | | | | | | | | | |
| According to International Patent Classification (IPC) or to both national classification and IPC | | | | | | | | | | | | |
| B. FIELDS SEARCHED | | | | | | | | | | | | |
| Minimum documentation searched (classification system followed by classification symbols) IPC : H03H/IC; H04M/IC | | | | | | | | | | | | |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched INTERNET | | | | | | | | | | | | |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT: filter and loss and (switch or select) and (correct or adjust or change or eliminate or suppress) | | | | | | | | | | | | |
| C. DOCUMENTS CONSIDERED TO BE RELEVANT | | | | | | | | | | | | |
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. | | | | | | | | | | |
| P,A | AU 36813/99-A1 (ALCATEL) 13 January 2000 whole document | 1-7,11,14 | | | | | | | | | | |
| P,A | WO 00/28660-A1 (VACUUMSCHMELZE GmbH et al) 18 May 2000 whole document | 1-7,11,14 | | | | | | | | | | |
| A | WO 99/40686 A1 (ADC SOLITRA, Inc.) 12 August 1999 whole document | 7 | | | | | | | | | | |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex | | | | | | | | | | | | |
| <p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E" earlier application or patent but published on or after the international filing date</td> <td>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table> | | | "A" document defining the general state of the art which is not considered to be of particular relevance | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention | "E" earlier application or patent but published on or after the international filing date | "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone | "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art | "O" document referring to an oral disclosure, use, exhibition or other means | "&" document member of the same patent family | "P" document published prior to the international filing date but later than the priority date claimed | |
| "A" document defining the general state of the art which is not considered to be of particular relevance | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention | | | | | | | | | | | |
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| "O" document referring to an oral disclosure, use, exhibition or other means | "&" document member of the same patent family | | | | | | | | | | | |
| "P" document published prior to the international filing date but later than the priority date claimed | | | | | | | | | | | | |
| Date of the actual completion of the international search 6 October 2000 | | Date of mailing of the international search report 11 OCT 2000 | | | | | | | | | | |
| Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929 | | Authorized officer JAMES WILLIAMS Telephone No : (02) 6283 2599 | | | | | | | | | | |

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/00995

| C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT | | |
|---|---|-----------------------|
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| X A | US 5,608,237-A (Aizawa et al) 4 March 1997 whole document especially figures 3,4,5 and 17 whole document | 8,12 9,10,13 |
| X A | US 5,349,242-A (Tanaka et al) 20 September 1994 whole document, especially figures 3 and 4, column 4 line 31 to column 6 line 19 whole document | 8,12 9,10,13 |
| A | US 6,078,794-A (Peckham) 20 June 2000 whole document | 7 |

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/00995

Box I Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos :
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos :
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos :
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Claims 1-6 and 11-14 are directed toward a filter arrangement
Claim 7 is directed toward a communication line return loss arrangement.
Claims 8-10 are directed toward a polarity insensitive switch

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☒ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU00/00995

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

| Patent Document Cited in Search Report | | | | Patent Family Member | | | |
|--|----------|----|----------|----------------------|------------|----|---------|
| AU | 36813/99 | EP | 967736 | JP | 2000151470 | CN | 1244072 |
| WO | 00/28660 | DE | 19851872 | | | | |
| WO | 99/40686 | AU | 24927/99 | | | | |
| US | 5608237 | JP | 7307469 | | | | |
| US | 5349242 | JP | 4229715 | | | | |
| US | 6078794 | CN | 1191422 | FR | 2759823 | GB | 2322493 |
| END OF ANNEX | | | | | | | |

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